cIVF vs ICSI in non-severe male factor cycles: a sibling-oocyte split insemination strategy and fertilization success

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Study question

What is the impact of sibling-oocyte split insemination strategy using conventional IVF and ICSI on fertilization outcomes in non-severe male factor cycles?

Materials and Methods

Retrospective cohort study of 29,962 sibling oocytes from 2,811 PGT-A cycles (2017–2024), split 40/60 between cIVF and ICSI. Day-1 outcomes were classified as 2PN, not fertilized, abnormal, or degenerate. Euploidy rate was assessed in biopsied blastocysts. Counterfactual whole-cycle and embryo-level analyses (Dirichlet–multinomial posterior prediction) estimated fertilization efficacy under alternative insemination strategies. Risk groups (LOW/MEDIUM/HIGH) were defined by Q1 and Q3 of the cycle-level ICSI degeneration and cIVF poor-fertilization distributions.

Results

Across all embryos, the distribution was: 2PN 75.2%, not fertilized 9.39%, abnormal 9.69%, degenerate 5.76%. At cycle level, ICSI outperformed cIVF in 45.1%, cIVF outperformed ICSI in 42.4%, with tied outcomes in 12.5%. ICSI showed slightly higher 2PN than cIVF (76.0% vs 74.0%; OR 1.11, 1.05–1.17, p<0.001) but higher degeneration. TFF occurred in 0.9% of cycles; counterfactual modelling predicted higher TFF under only-cIVF (1.35%, p=0.008) and borderline higher under only-ICSI (1.19%, p=0.056).

Figure 1 shows stratified analyses showed strong effect modification: cIVF benefited cycles with high ICSI degeneration (+13.4 pp 2PN, −27.9 pp degeneration), while ICSI benefited cycles with high cIVF poor-fertilization (+32.8 pp 2PN). Euploidy was similar between cIVF and ICSI (47.8% vs 48.0%; adjusted OR 0.98, p=0.64).

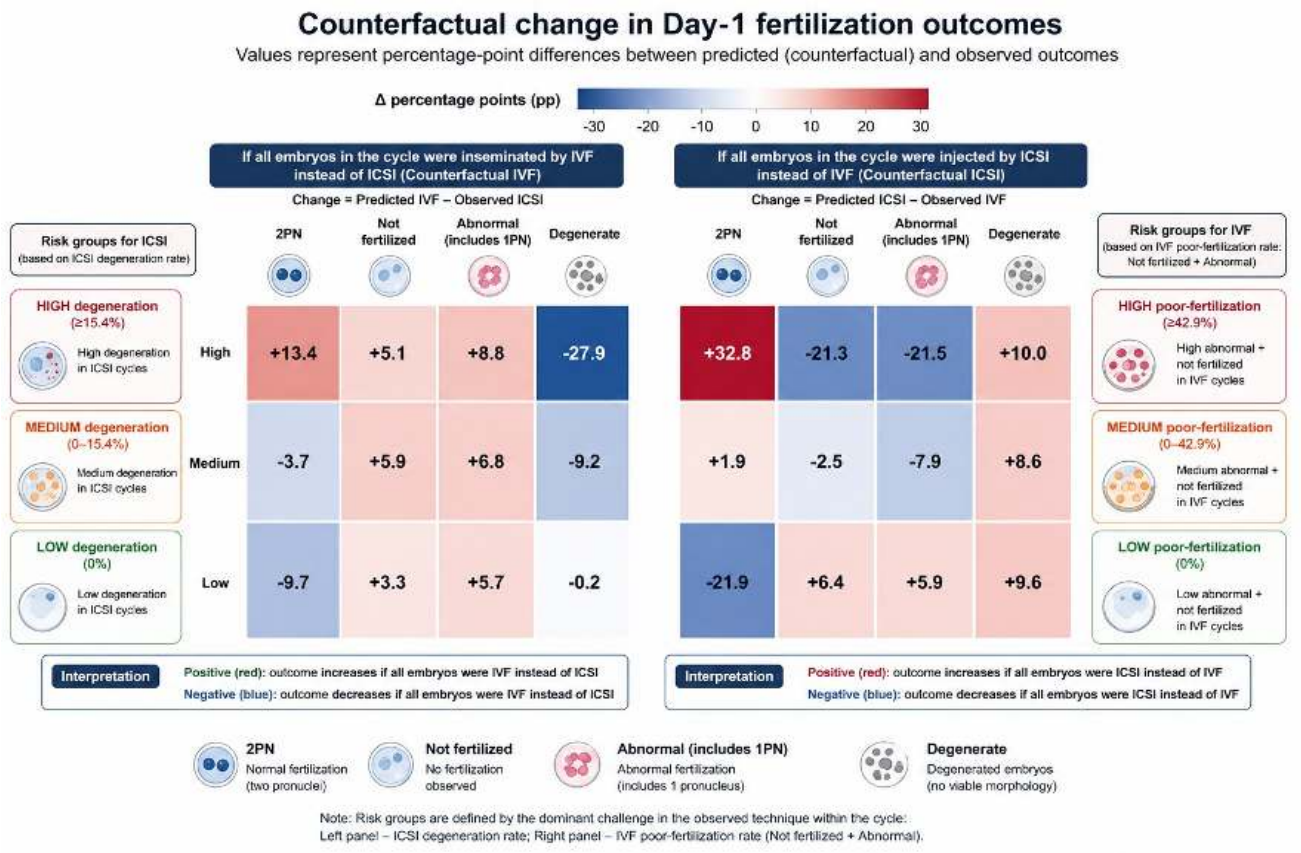

Figure 1. *Counterfactual ("only-cIVF" and "only-ICSI") vs observed Day-1 outcomes, estimated via Dirichlet–multinomial posterior prediction. Cycles were stratified by ICSI degeneration rate (left) and cIVF poor-fertilization rate (right), with LOW/MEDIUM/HIGH groups defined by Q1 and Q3. Values are percentage-point differences.*

Conclusion

These findings suggest that split cIVF/ICSI insemination may improve cycle-level fertilization success and minimize total fertilization failure in non-severe male factor cycles, while supporting efficient use of laboratory resources without compromising euploidy safety.

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